

Fatal Incident in a Refinery: Exposure to H₂S

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A fatal accident took place in the Sour Water Stripper Unit (SWSU) of a refinery. The incident occurred in the early morning hours in the sour water stripper unit while field operator was preparing to collect the stripped sour water sample from the sampling point. The operator went to collect sample as per routine duty. He got exposed to concentrated H₂S vapour and collapsed near the point of sampling due to inhalation.

OISD team conducted investigation to find out the root cause analysis and the learnings from the incident to avoid recurrence.

The events as gathered by OISD team are enumerated:

- The night shift operator had gone to collect samples of sour water, stripped water, rich amine and lean amine samples as per normal routine sampling.
- The H₂S vapour which got escaped from the nearly open OWS manhole settled down at grade level as it is heavier than air.
- The operator might have approached the sampling point along with sample bottle but could not collect the sample as intended but was found lying unconscious on the floor near the sample point.
- The morning shift operator who came for duty didn't find the night shift operator relieving him from duty.
- The operator went to the "Check & Change Room" and found the locker of night shift operator in open condition.
- Worried he went to the site immediately and near to sample collection point via SRU & amine recovery unit.
- When he approached the sample collection location, his personal H₂S responder gave alarm; indication of more than 20 ppm of H₂S.
- Since the operator was not carrying his canister, rushed back to check & change room and returned back with canister to the sampling point.
- He observed the night shift operator lying on the floor and immediately informed shift in charge.
- Subsequently, he pulled the unconscious operator away from the site for fresh air while ambulance and fire and safety crew reached the site.
- The victim was removed from the site and taken to hospital.
- The doctor declared that the victim was brought dead to hospital.

Sour water from FCC, CDU and Coker Units are received in the Degassing Drum. The drum floats with acid gas flare system. Depending upon the level of hydrocarbon separated in the

reservoir of degassing drum, as per the extant practice of the refinery, oil is drained time to time in OWS through a funnel. Sour water is fed to sour water stripper column for removal of H₂S. The stripped sour water is consumed in de-salter in Crude Distillation Unit. The excess quantity, if any, is drained to OWS. There were occasions when stripping was found improper which is corroborated by lab results that indicated presence of H₂S beyond the stipulated limits. Hydrocarbon from degasser drum was also drained into OWS funnel instead of CBD. However, the liquid drained overflowed from the funnel indicating choke in the line.

The other findings by the investigation team are:

- H₂S level was checked in the vicinity and was found above 40-50 ppm level which is beyond the safe limit.
- The reading of the level transmitter draining water on the degassing drum was found at zero (-2.9); under such circumstances, if the valve is left open, H₂S inevitably would escape.
- The H₂S detector, which is near the HC drain funnel, was found non-functional.
- The operator who had gone to collect the sample did not carry any personal hydrocarbon detector, gas canister which was confirmed through discussions with Fire & safety as well as Operation Personnel.
- No evidence of H₂S detector or PPE was found near the place where the victim was found lying unconscious.
- The level of alarm is audible and had he carried the above item, he would have escaped unhurt.

ROOT CAUSE OF THE INCIDENT

The abnormalities noted during the entire episode & root cause of the accident leading to fatality are:

- Occasional increase of H₂S level (beyond 10 ppm) in the stripped water due to improper operation of the stripped sour water system.
- The control philosophy i.e. feed to sour water stripper thru LIC need to be changed to FRC for steady flow of sour water to stripper.
- Draining of water from degasser drum or any H₂S contaminated water should be only to closed blow down system.
- Releasing/draining of excess stripped water into OWS manhole fitted loosely with metal box type cover.
- H₂S might have also escaped to OWS system from the degasser drum since the level was Zero; the drum floats with acid flare gas.

- Lots of H₂S vapours escaped through OWS system - since the line was choked.
- The operator who went for sampling did neither carry the H₂S detector or used PPE which is a gross violation of norm.
- The H₂S detector alarm in the control room was overlooked by panel man or was kept in bypass mode which is again a serious violation of system.
- The events as above which resulted in H₂S rich environment & its inhalation resulted in fatal accident.

LEARNINGS

- The feed to sour water stripper is based on LIC control and must be changed to FRC control system to ensure steady flow of sour water to stripper.
- No H₂S contaminated liquid must be drained into open system instead it should be drained to CBD.
- Draining the excess stripped sour water, if any, should be routed to closed blow down system only.
- Instruction to carry personal responder/PPE during every field visit/sampling should be strictly implemented.
- Operating personnel should be educated regarding the hazardous nature of H₂S and its detrimental impact on living beings as well as on the environment.
- One H₂S detector should be installed very close to OWS manhole for detection of H₂S.
- All H₂S detector installed in the field must be in working condition.
- Whenever any operator goes to the field visit, he should be instructed to inform his fellow operator in the change room.
- Safety interlock should be made functional and kept on line.
- High level H₂S alarm at control room must be acknowledged by the panel operator so that timely appropriate action can be taken.